

What Is the Optimal Nutrition for an Individual with Genetic Polymorphisms?

YASUO KAGAWA, M.D.

Vice President

Women's University of Nutrition

Kagawa Nutrition University

< Summary >

The author is on the editorial board of the Japanese edition of “Nutrition Reviews” published by ILSI Japan, which focuses on scientific input related to nutrition and physical activity, food safety, chemical risk assessment and environmental health. In short, ILSI provides people with information on optimal nutrition, which is wider in scope than recommended dietary allowance (RDA). RDA is based on the estimated average requirement (EAR: the intake simply sufficient to satisfy the needs of 50% of the subjects) and the standard deviation (SD) obtained by balancing studies on large numbers of subjects. Therefore, RDA (defined as EAR+2SD) is intended to cover the nutritional requirements of 97.5% of subjects. However, optimal nutrition covers wider scope than RDA due to the following 4 reasons.

1. Polymorphism and predictability: The statistics of the RDAs assumes nearly normal distribution of the data, which is not always true in populations composed of many genetic polymorphisms. For example, the guideline recommends ethanol intake <20 g/day, but some people become intoxicated by only 1 g/day, while others can drink 200 g/day without significant impaired performance. Optimal personalized nutrition based on polymorphism enables not only appropriate treatment but also prediction of the risk for prophylaxis. C677T-TT, an SNP of MTHFR found among 15% of the population, is associated with a 3.5-fold higher risk for stroke as compared to the wild type, and for TT, 400 μ g folate/day are needed, instead of RDA (240 μ g).

2. Long-term gene expression and bioactive substances: Development of a lifestyle-related disease is the result of long-term gene expression, but RDA is based on short-term balance studies. Optimal nutrition is based on long-term follow-up studies, and includes bioactive substances such as anticancer or hypotensive agents in functional foods, while RDA does not. The effects of functional foods must be established by analyzing gene expression. Enzyme synthesis of digestive tract decreases with age, so nutrients may be administered in semi-digested form. Large ethnic differences of the effects of bioactive substances, lactose, etc. must be considered in optimal nutrition.

3. Mental activity is supported by both clock and personality genes: RDA is determined by physical activity, but human optimal nutrition aims to optimize mental activity also. For this, the genes for both circadian activity and personality are important. RDA does not specify the timing of

meals, but central and peripheral clock genes are regulated by morning light and breakfast. Human nutritional expenditure is governed by the cortex, which can be activated by many bioactive substances including caffeine. Folate and n-3 fatty acids are effective in the prevention of dementia and depression.

4. People are voluntary agents and have individual goals: The final target of personalized optimal nutrition is the individual's goal. Human beings do not simply live in order to prolong life spans by following uniform RDA guidelines. For example, some sports produce harmful reactive oxygen species. To counteract this, several preventive substances may be used in order to attain optimal nutrition. Genome-wide association studies on 1,000,000 polymorphisms are used to determine optimal personalized nutrition.

Finally, application of optimal personalized nutrition has been effective in our Nutrition Clinic in promoting health indices, and in reducing medical expenses of Sakado City in 2006. Future activities of ILSI Japan are expected.